speculum gave a slight reddish tint to all objects); now the companion is bluish white, and between these two epochs it showed more saturated colours.

The short period of ζ Herculis (34·32 years) allows us to consider the changes of colours during two revolutions. Herschel measured this system about the epoch when the companion was very near to the primary; the latter was white, the former ash-coloured. At the periastrium of 1860 Mr. Knott saw them pale yellow and greenish respectively; at other epochs the colours of the two components are all the more marked the further they are away from the periastrium, the companion always showing warmer tints than the principal star. About the epoch of the apparent periastrium M. Dembowsky designated them as yellow and olive coloured. Similar phenomena are shown by the other double stars given in the table, all of which are systems with closed, *i.e.*, elliptical orbits. In the double star 61 Cygni, where no closed orbit has been observed, but where the small companion moves in a straight line relatively to the larger one, the same yellow tint has been observed from 1828 to 1873.

In the cases of optical double-star systems, *i.e.*, those which only accidentally happen to be in the same line of sight, and which show a rectilinear motion, the principal star is generally yellow and the companion blue. In Mr. Brothers' catalogue, which comprises 105 double-star systems, with closed orbits, there are only thirty-two where the companion is blue, while all the others show the same colour as the principal star. And even these thirty-two systems may possibly be optical ones, in which the companion is almost exclusively blue. The absence of blue in the companions of double stars of short period is most remarkable.

The blue colour of the companions in the optical systems is not an effect of contrast to the yellow colour of the primaries, for the former are blue even if the latter are shut out of the field of vision. It seems possible that, similar to the effect in our atmosphere, where distant objects assume a bluish tint, celestial bodies which send us their rays of light from the most distant regions, may appear blue on account of the thickness of the medium through which the light passes.

M. Niesten has compiled a table of double stars with blue companions, and has arranged them according to their position in declination and right ascension. From this it appears that these double stars are principally situated in a zone extending from decl. 10° S. to 40° N., and further that there are two maxima of occurrence, one in R.A., 4h.–6h. and the other in R.A. 18h.–20h.; the first maximum is near the equator, the other between Decl. 30° and 40° N.; the former is therefore in the constellation of Orion, the latter in Cygnus and Lyra. According to Sestini, the single blue stars occur in the same parts of the heavens.

The conclusions we may draw from M. Niesten's researches are as follows:—

1. In systems with well-established orbits, and particularly in those of short period, the two components generally have the same yellow or white colours.

2. In systems of which we possess sufficiently numerous records of the colours of the components to enable us to perceive a relation between the tints and the relative positions of primary and companion, the former is white or pale yellow when the latter is in its periastrium, while in other positions the primary is yellow, golden yellow, or orange.

3. In these systems the companion follows the colour-fluctuations of the principal star, and frequently surpasses the latter in intensity of tint the further it moves away from the periastrium, at which point in most cases its light is white, like that of the primary.

4. An equality of tints of primary and companion is found in systems with rectilinear motion, as well as in those with closed orbits and long periods.

5. In optical groups the companion is generally blue.

These remarks are, of course, founded upon observations made by different observers, and the records of colour may thus suffer from personal influences; but in many cases one and the same observer recorded the colours of the components of a system as yellow during a series of years, and then he saw them grow paler and turn white. In other instances all astronomers agree that a certain companion is blue.

When more careful attention has been given to the question of colours, both in measuring double stars as well as in investigations of the physical condition of planets, then it will be possible, perhaps, to draw a great many more conclusions, and such to which greater probability attaches, than was in the power of M. Niesten, with the comparatively small number of observations at his command.

At present it is supposed that the fluctuations of colour in stars are caused by changes in the composition of their incandescent gaseous envelopes; these changes must in turn be only effects of another cause producing them; M. Niesten does not think it impossible that in the case of double stars this cause might lie in the relative position of the components.

SCIENTIFIC SERIALS

American Chemical Journal, vol. i., Nos. 2 and 3, present a good array of contributions from different American universities, making in all, with reviews and reports, about 215 pages. Under inorganic chemistry is to be found a description of very slightly modified methods of nitrogen and phosphorus estimation adapted to agricultural products, by Johnson and Jenkins; and a series of analyses of gummite and other uranium minerals from North Carolina, by E. Genth, &c. Among the contributions to organic chemistry is a long paper by Remsden and Iles on the oxidation of substitution products of aromatic hydrocarbons, continued from No. 1. In the first portion the authors describe solid orthokresol from their oxytoluic acid, and they further conclude from their experiments that the presence of a sulphamine group acts protectively towards a methyl group in a substituted aromatic compound submitted to oxidation. A full abstract of this and another interesting paper by Remsden and Morse on oxidation of bromparaethyltoluene, and researches on substituted benzyl compounds, by Jackson, cannot be given in our space. Thorpe on heptane has appeared elsewhere. The remaining communications are of minor interest.

Bulletin de la Académie Royale des Sciences (de Belgique), No. 5.—The yellow substance obtained when tetrathionic acid is poured into a solution of mercurous nitrate in water has been proved by M. Spring to be a *trithiobasic sulphate of mercury*. This substance showed some unexpected chemical properties, which M. Spring describes, and he has succeeded in forming some other new bodies similar to it, so as to complete the list of basic sulphates of mercury sufficiently for an attempt at classification of these substances.—The recent terrible catastrophe at the Agrappe coal-pit is the occasion of two communications by M. Cornet and M. Melsens, the former remarking especially on the influence of depth on the instantaneous irruption of fire-damp, and the proportion of that gas met with. (The fire-damp of the Agrappe pit, which ignited at the mouth of the pit, came from 610 metres depth, where a new gallery was being made.)—M. Renait's paper on the distinctive characters of dolomite and calcite in rocks of the carboniferous limestone of Belgium is elsewhere noticed.—There are also here two notes on Belgian minerals.

THE *Rivista Scientifico-Industriale*, Nos. 11-13, contain the following papers of importance:—Researches on the electric conducting power of carbons, by Prof. Rinaldo Ferrini.—On some new applications of the potential energy of liquid surfaces, by G. Van der Mensbrugghe, discussed by Prof. C. Marangoni.—On a telephonic microphone, by Prof. G. Cantoni.—On the endosmose of liquids and on an apparatus for filling endosmometers, by Prof. C. Marangoni.—On the mutual dependence of simple bodies, by P. Provenzali.—On some prehistoric discoveries made at Ostiano, by Dr. Ciro Chistoni.—On a new saccharometer or polarimeter, by M. Laurent.—On the kinzigite of Calabria, by Domenico Lovisato.—On the determining causes of the sexuality of *Cannabis sativa*, by Prof. P. A. Saccardo.—On the constitution of fog and clouds, by Prof. Fernando Palagi.—On a new burner for monochromatic light.—On the phenomena which accompany the electrolysis of metallic compounds, by Prof. Giuseppe Basso.—Crystallographical, optical, and chemical researches on certain minerals, by Prof. Giuseppe Grattarola.—On a new method to determine the melting-point of organic substances, by Prof. Giorgio Roster.

THE *Revue Internationale des Sciences* (June and July).—From these parts we note the following papers:—Analysis of Prof. Ernst Haeckel's treatise, "Monogenetic and Polygenetic Origin of the three Organic Kingdoms and of the Organs," by Jules Soury.—Description of the scientific balloon ascent of October 31, 1878, and remarks on the exploration of great aërial heights, by Louis Tridon.—On the Diatomaceæ of the mouth of

the Seine, by M. Manoury.—On the secreting and trophic nerves of glands, by R. Heidenhain.—On the colouring-matter of urine, by M. Masson.—On the beginnings of art, by Dr. Johannes Ranke.—On the circulation of gases and some phenomena of gaseous thermo-diffusion in plants, by J. L. de Lanessan.

Reale Istituto Lombardo di Scienze e Lettere, Rendiconti, vol. xii. fasc. xiii.—We note here the following:—Anatomical and statistical note on cirrhosis of the liver, by Prof. Sangalli.—On albinism in batrachians, by Prof. Pavesi.—On polar systems (continued), by Prof. Jung.—On monodromic functions having a characteristic equation, by S. Pincherle.—Rapid preparation of hydroxylamine, by Dr. Bertoni.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, July 21.—M. Daubrée in the chair.—The following papers were read:—Theory of the simple pendulum with conical oscillations, regard being had to the rotation of the earth, by M. Villarceau. He concludes that other causes than gravity and the earth's rotation intervene.—Various thermo-chemical data, by M. Berthelot. This relates to formation of diamylene, and heat of fusion and specific heat of glycerine.—Remarks on the last communication of M. Bouquet de la Grye, by M. Ledieu. He doubts the possibility of determining, even approximately, the influence of the sun and the moon on atmospheric pressure.—The last three epidemics of plague of the Caucasus, studied with regard to epidemiology and prophylaxy, by M. Tholozan. These epidemics appeared in 1804-18, 1828-30, and 1840-43. He remarks on the inefficacy of means expected to be effectual for staying the progress of the disease.—M. Schwann was elected correspondent in Medicine and Surgery, in place of M. Rokitanski.—Astronomical observations and measurement of an arc of parallel in Algeria, by M. Perrier. The arc embraces 10°. The triangulation is destined to serve for basis and control of the vast system covering Europe.—Anæsthesia by means of protoxide of nitrogen mixed with oxygen, and employed under pressure, by M. Bert. One operation, by M. Labbé, is described, and sixteen, by M. Pean, referred to. The superiority of the method is chiefly shown in the instantaneousness of the sleep and awaking. There is hardly any nausea. The excess of pressure varied between 0·15 m. and 0·22 m.—Researches on the causes of reinvasion of phylloxerised vineyards, by M. Boiteau.—M. Colladon announced the death of M. Favre, contractor of the Saint Gothard tunnel.—Discovery of a small planet by Mr. Peters at Clinton (N.Y.), on July 17, 1879.—On a generalisation of periodic functions and on certain linear differential equations, by M. Picard.—Hydrodynamic experiments with vibrating bodies, and imitation, in an inverse sense, of the forces of electricity and magnetism, by M. Bjerknes. He describes a modified form of his former apparatus.—On a phenomenon similar to that of Peltier, by M. Bouty. This relates to the experiment with metallised thermometers as electrodes, referred to elsewhere.—On the capacity of voltaic polarisation, by M. Blondlot. The following law is deduced from observations:—For a given electrode and a given electrolyte the initial capacity does not depend on the direction of polarisation.—Action of magnetism in motion on static electricity, by M. Lippmann. This action results rigorously from the existence of the inverse phenomenon, which Mr. Rowland's experiments have demonstrated; and this reversibility is a consequence of the impossibility of perpetual motion. Further, static electricity has a proper mechanical inertia, simply added to that of the electrified body.—On the laws of variations of atmospheric electricity deduced from regular observations made at the Moncalieri Observatory, by M. Denza. *Inter alia*, there are two principal daily maxima, a few hours after sunrise and sunset. The monthly electric tension reaches a maximum in February, a minimum in September. In twelve years negative electricity appeared with rain and snow, at least in 50 per cent. of the cases. The electric tension generally diminishes with the altitude.—Researches on explosive substances, by MM. Nobel and Abel.—Experimental researches on decomposition of gun-cotton in a closed vessel, by MM. Sarrau and Vieille. The pressure, heat, and volume and composition of the gases, are indicated. The latter are simple and few.—On the employment of sulphuretted hydrogen by the dry method in analyses, by M. Carnot. This mode of sulphuration has advantages, in many cases, over that of fusion with sulphur.—On the transformation of hydrocellulose into pulverulent pyroxyles, by M. Girard.—Action of fluoride of boron on acetone, by M. Landolph.—On the determination of urea, by M. Mehn.—On iron reduced by hydrogen, by M. Moissan.—Electric excitation of the point of the heart, by MM. Dastre and Morat. A series of closely successive currents may have on the heart the effect of a continuous current.—Note on the physiological action of bromhydrate of conine, by M. Prevost.—On the biliary secretion, by M. Picard. There are two differences between this and the renal secretion:—(1) An arterial system furnishes urine, a venous system bile; (2) In the biliary secretion certain substances formed in the liver are carried away by the outward movement of the liquid.—Action of the principal poisons on crustacea, by M. Yung. Strychnine and nicotine act with extreme violence; curare is less active than with vertebrates; sulphate of atropine never caused death; digitaline renders the heart's movements slower, &c.

VIENNA

Imperial Academy of Sciences, May 8.—The following among other papers were read:—Old and new methods of solving differential equations by simple determinate integrals, by Prof. Winckler.—Researches on liverworts (Ricciæ), by Prof. Leitgeb.—Determination of path of two fireballs observed on January 12 in Bohemia and neighbouring regions, by Prof. Niessl.—On the employment of quarter-tones in music on the doubly chromatic piano, by Herr Gruss.—New conchylia from Mediterranean strata, by Dr. Hilber.—Diluvial land-snails from Greece, by the same.—On the *rôle* of the *Ligamentumiridis pectinatum*, by Dr. Biggs.—On compounds from animal tar, I. Picolin, by Prof. Barth.—On the internal friction in a mixture of carbonic acid and hydrogen, by Dr. Puluj.

May 15.—On the electro-magnetic rotation of the plane of polarisation of light in air, by Prof. Lippich.—On arsenate of zinc and cadmium, by Herr Demel.—On two peculiar surfaces of the sixth order, and on a certain group of curves of the third and fourth order, by Herr Cantor.—On tertiary fossils brought by Dr. Tietze from Persia, by Herr Fuchs.

May 23.—On the formation of cinchomeronic acid from chinine, and its identity with a pyridindicarbonic acid, by Dr. Weidel and Herr Schmidt.—Action of oxalic acid on carbazol, by Dr. Sinda.—On the decomposition of sulphydantoin by baryta hydrate, and on a peculiar iron-reaction of thioglycolic acid, by Herr Andreasch.—On bromoxyl derivatives of benzol, by Dr. Benedikt.—On the fossil fauna of the Vypustek cave in Moravia, by Prof. Liebe.

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